LS-34
October 23, 1985
YC/AVR

6 GeV LIGHT SOURCE PROJECT

COST ESTIMATING PROCEDURE

To maintain uniformity in estimating the cost requirements of the various components of the 6 GeV Light Source, the following procedure will be used by all the task groups. The procedure uses a Work Breakdown Structure (WBS) to break down the project into manageable, easy to estimate, components. The project is first broken down into major tasks or categories. Then each major division is continuously subdivided until the desired level of detail is achieved. This can be shown best by using the example of the WBS of the Aladdin Upgrade Project, excerpts of which are included in Appendix A. As shown in the example, the project is first divided into:

1.1 Project Management and Administration
1.2 Accelerator Physics
1.3 Special Research Facilities - Aladdin
1.4 Special Research Facilities - Experimental
1.5 Conventional Facility - Building, Utilities, Shielding
1.6 Contingency

For this example, "1.3 Special Facility - Aladdin" is further subdivided:

1.3.1 Aladdin Ring
1.3.2 Injector Transport System
1.3.3 Accelerator Control System
etc.

Continuing, "1.3.1 Aladdin Ring" is again subdivided into:

1.3.1.1 Ring Magnets
1.3.1.2 Ring Vacuum System
1.3.1.3 Survey and Alignment
etc.

This subdivision procedure continues level by level until the desired detail is achieved. At that point a detailed cost estimate can be made for the particular component. After having calculated the cost of the individual components, one can, by multiplying and adding costs, easily calculate the cost of a subsystem, system or the whole project.

A preliminary draft of a Work Breakdown Structure for the 6 GeV Light Source Project is included in Appendix D. It is far from complete, but is included to provide an initial starting point.

DETAILED COST ESTIMATE

A spread-sheet format for the detailed cost estimate is shown in the Aladdin example on page A-5. Two work sheets are provided for the detailed cost estimate. The Detail Cost Estimate form (Form A) provides for the most detailed level of estimating to be used. The Summary Cost Estimate form (Form B) is used to summarize the data from the detailed cost estimate forms. It can also be used as a summary sheet at each WBS level. The headings should contain the names of the major component/system and subcomponent/subsystem, the appropriate WBS number, date of estimate and the name of the estimator. On Form A, each item of the component is identified by item number and title. The detailed cost estimate is divided into material cost and labor cost.

Material Cost

The "Material" section is used to describe both "raw" material costs and the "finished" material costs of purchased or manufactured parts. The "unit measure" column should show indications of "lbs", "feet", "each", "gals", etc. The "no. of units" column should indicate the quantity required for this component. The "unit cost" column should show the cost of one unit and the "cost basis" column must indicate how the cost was calculated using the following COST BASIS CODES:

VQ - Vendor Quotation
CP - Catalog Price
EU - Estimated but Undocumented Price
A79 - Actual cost from '79 (escalated to FY86$)
A80 - Actual cost from '80, etc. - any year.

The standard escalation rates listed in Appendix B (Parts A and B) should be used for calculating the actual cost (in FY86$) from other years.

Labor Cost

The labor costs are broken down into number of units, the number of hours required per unit and the total number of hours required for all units. The "craft code" column defines the type of labor required and the hourly cost of that labor. The craft codes and hourly rates are listed in Appendix C. All labor/effort will be estimated in "hours" with the following assumptions:

1 M-day	=	8 hours
1 M-week	=	40 hours
1 M-month	=	166 hours
1 M-year	=	2000 hours.

Special attention must be paid to the Davis-Bacon Act for many of the crafts. Manufacturing and installation crafts are usually assumed to be outside personnel, and technical effort can be assumed to be from within the Laboratory.

Example

The example on page A-5 shows how all this comes together. The example covers WBS code number 1.5.3.4 Beam Line Radiation Safety. It is a part of WBS 1.5.3 Radiation Safety, which is a part of WBS 1.5 Conventional Facilities - Building Modifications, Utilities, Shielding. Following the example by item number, one can observe:

1. Purchase materials for 20 safety shutters at $14k each for a total of $280k. The cost of materials is estimated but undocumented (EU).

2. Fabrication will require 40 hours per shutter for a total of 800 hours of a regular, non-specialized, shops person (S1) at a rate of $40.00 per hour.

3. Assembly will require 10 hours per shutter by a skilled technician (T2) at a cost of $40.38 per hour.

4. Installation and testing will also require 10 hours per shutter of the skilled technicians time at the above rate.

5. Drafting and documentation of this one package will require 20 hours of a draftsman (DR) at a rate of $34.60.

The example continues by describing the material and labor costs for beam line vacuum valve interlocks. It should be obvious that this particular WBS detailed cost estimate should have been broken down further into two cost estimates:

1.5.3.4.1 Safety Shutters
1.5.3.4.2 Vacuum Valve Interlocks.

6-GEV SR SOURCE
DETAIL COST ESTIMATE

PREPARED BY _____

SUBSYSTEM _____

MAJOR SYSTEM _____

WBS CODE	COMPONENT	DATE	PAGE OF
ESTIMATOR	MATERIAL	LABOR	

ITEM#	ITEM TITLE	UNIT MEAS.	NO. UNITS	UNIT COST	COST BASIS*	TOTAL MT K$	NO. UNITS	UNIT HRS.	TOTAL HOURS	CRAFT CODE*	$/HR*	TOTAL LABOR K$

BRIEF TECHNICAL DESCRIPTION OF THIS WORK PACKAGE:

* SEE INSTRUCTION PAGE FOR CODE IDENTIFIERS

K$	SUBTOTALS, THIS PAGE	K$

6-GEV SR SOURCE
SUMMARY COST ESTIMATE

FABRICATION/CONSTRUCTION/INSTALLATION

MAJOR SYSTEM _____ PREPARED BY _____

WBS CODE	SUBSYSTEM	DATE	PAGE OF
ESTIMATOR	COMPONENT		

DETAIL EST WBS/PG NO	DESCRIPTION	MAT'L K$	LABOR K$	TOTAL K$	QTY REQD	MAT'L K$	LABOR K$	GRAND K$
	GRAND TOTAL THIS W.B.S.							

APPENDIX A

ALADDIN UPGRADE ROLLUP
11 APRIL 85

A L A D D I N U P G R A D E

1.	ALADDIN UPGRADE - COST ESTIMATE (FY 85)			K $ 18339.22
1.1	PROJECT MANAGEMENT AND ADMINISTRATION			0.00
1.2	ACCELERATOR PHYSICS			668.00
1.3	SPECIAL RESEARCH FACILITIES - ALADDIN			13656.62
1.3.1	ALADDIN MAIN RING		4864.81	
1.3.1.1	RING MAGNETS		93.22	
1.3.1.1.1	DIPOLES	25.00		
1.3.1.1.2	QUADRUPOLES	4.00		
1.3.1.1.3	SEXTUPOLES	0.00		
1.3.1.1.4	CORRECTING MAGNETS	2.40		
1.3.1.1.5	SUPPORTS	34.42		
1.3.1.1.6	GIRDER ASSEMBLY	24.00		
1.3.1.1.7	INSTALLATION	3.40		
1.3.1.1.8	EDIA	0.00		
1.3.1.2	RING VACUUM SYSTEM		1100.80	
1.3.1.2.1	VACUUM CHAMBERS	125.50		
1.3.1.2.2	PUMPING SYSTEM	143.70		
1.3.1.2.3	ASSEMBLY & MISCELLANEOUS	773.80		
1.3.1.2.4	BEAM POSITION ELECTRODES	8.40		
1.3.1.2.5	CLEARING ELECTRODES	18.90		
1.3.1.2.6	INSTALLATION	0.00		
1.3.1.2.7	EDIA	38.50		
1.3.1.3	SURVEY & ALIGNMENT		48.00	
1.3.1.3.1	MONUMENTS	6.30		
1.3.1.3.2	SURVEY INSTRUMENTS	25.50		
1.3.1.3.3	ALIGNMENT FIXTURES	14.00		
1.3.1.3.4	TRANSPORT LINE	3.00		
1.3.1.3.5	ALADDIN RING	0.00		
1.3.1.3.6	EDIA	0.00		

1.3.1.4	RING MAGNET POWER SYSTEM		228.56	PAGE 2
1.3.1.4.1	BEND MAGNET SYSTEM	26.86		
1.3.1.4.2	QUADRUPOLE MAGNET SYSTEM	100.90		
1.3.1.4.3	SEXTUPOLE SYSTEM	0.00		
1.3.1.4.4	CORRECTING SYSTEM	0.00		
1.3.1.4.5	DC DISTRIBUTION	7.20		
1.3.1.4.6	EDIA	94.40		
1.3.1.5	RING RF SYSTEM		1156.83	
1.3.1.5.1	ACCELERATING CAVITY	296.67		
1.3.1.5.2	RF POWER SYSTEM	94.61		
1.3.1.5.3	HIGH VOLTAGE P.S.	0.00		
1.3.1.5.4	CONTROL RACK & LOW POWER RF EQPMT.	93.70		
1.3.1.5.5	INSTALLATION	0.00		
1.3.1.5.6	EDIA	671.85		
1.3.1.6	RING LOW LEVEL ELECTRONICS		1428.60	
1.3.1.6.1	VACUUM MONITORING AND POWER	187.90		
1.3.1.6.2	BEAM DIAGNOSTICS	550.20		
1.3.1.6.3	BEAM FEEDBACK	47.80		
1.3.1.6.4	CONTROL ROOM ELECTRONICS	80.40		
1.3.1.6.5	COMMUNICATIONS	10.40		
1.3.1.6.6	TIMING	84.00		
1.3.1.6.7	BEAM STEERING	163.50		
1.3.1.6.8	EDIA	296.40		
1.3.2	INJECTION TRANSPORT SYSTEM			1627.10
1.3.2.1	BEAM TRANSFER MAGNETS		390.20	
1.3.2.1.1	DIPOLE MAGNETS	42.00		
1.3.2.1.2	QUADRUPOLE MAGNETS	102.00		
1.3.2.1.3	TRIM & STEERING MAGNETS	35.00		
1.3.2.1.4	DC SEPTUM MAGNETS	49.70		
1.3.2.1.5	KICKER MAGNETS(IN 1.3.2.3.5)	0.00		
1.3.2.1.6	SUPPORTS	40.00		
1.3.2.1.7	AC SEPTUM MAGNET	60.30		
1.3.2.1.8	INSTALLATION	0.00		
1.3.2.1.9	EDIA	61.20		
1.3.2.2	BEAM TRANSFER VACUUM SYSTEM		277.10	
1.3.2.2.1	TRANSPORT CHAMBERS	46.80		
1.3.2.2.2	INJECTOR VACUUM PUMPING	34.20		
1.3.2.2.3	STRAIGHT SECTION BOX	153.10		
1.3.2.2.4	INSTALLATION	0.00		
1.3.2.2.5	EDIA	43.00		

1.3.2.3	BEAM TRANSFER POWER SYSTEMS		945.80	
1.3.2.3.1	DIPOLE POWER SYSTEMS	36.00		
1.3.2.3.2	QUADRUPOLE POWER SYSTEMS	24.00		
1.3.2.3.3	CORRECTING POWER SYSTEMS	48.00		
1.3.2.3.4	DC SEPTUM POWER SYSTEMS	32.80		
1.3.2.3.5	KICKER POWER SYSTEMS	578.20		
1.3.2.3.6	AC SEPTUM POWER SYSTEM	79.50		
1.3.2.3.7	DC DISTRIBUTION	15.00		
1.3.2.2.8	INSTALLATION	6.30		
1.3.2.3.9	EDIA	126.00		
1.3.2.4	BEAM TRANSFER LOW LEVEL ELECTRONICS		14.00	
1.3.2.4.1	VACUUM MONITORING AND PUMPING	0.00		
1.3.2.4.2	BEAM MONITORING	14.00		
1.3.2.4.3	EDIA	0.00		
1.3.3	ACCELERATOR CONTROL SYSTEM			944.71
1.3.3.1	NETWORK		171.09	
1.3.3.1.1	CONTROL VAX	0.00		
1.3.3.1.2	DEVELOPMENT VAX	131.30		
1.3.3.1.3	GATEWAY MICRO	8.13		
1.3.3.1.4	DEVELOPMENT MICRO	8.13		
1.3.3.1.5	SPARE MICRO	11.33		
1.3.3.1.6	INFRASTRUCTURE	12.20		
1.3.3.1.7	EDIA	0.00		
1.3.3.2	CONSOLES		314.40	
1.3.3.2.1	CONSOLE 1	83.20		
1.3.3.2.2	CONSOLE 2	83.20		
1.3.3.2.3	DEVELOPMENT CONSOLE	83.20		
1.3.3.2.4	PORTABLE CONSOLE	11.00		
1.3.3.2.5	EDIA	53.00		
1.3.3.3	STORAGE RING MICRO-COMPUTERS		266.72	
1.3.3.3.1	MAIN MAGNETS	19.15		
1.3.3.3.2	RF SYSTEM	12.43		
1.3.3.3.3	CORRECTION SYSTEM	70.42		
1.3.3.3.4	STEERING SYSTEM	51.22		
1.3.3.3.5	VACUUM SYSTEM	60.50		
1.3.3.3.6	EDIA	53.00		
1.3.3.4	BOOSTER MICRO-COMPUTERS		192.50	
1.3.3.4.1	MICROTRON	22.83		
1.3.3.4.2	SYNCHROTRON	22.47		
1.3.3.4.3	MISCELLANEOUS	10.50		
1.3.3.4.4	TRANSPORT LINE	17.93		
1.3.3.4.5	INJECTION	12.69		
1.3.3.4.6	EDIA			

				PAGE 4
1.3.4	800 MEV INJECTOR SYSTEM		7020.00	
1.3.4.1	SCANDITRONIX CONTRACT	7000.00		
1.3.4.2	SRC EFFORT & TRAVEL	20.00		
1.4	SPECIAL RESEARCH FACILS & EXPERIMENTAL			0.00
1.4.1	INSERTION DEVICES		0.00	
1.4.2	PHOTON BEAMLINES		0.00	
1.5	CONV. FACILS - BLDG MODS , UTILS, SHLD			1652.60
1.5.1	BUILDING MODIFICATIONS		109.40	
1.5.1.1	TUNNEL	94.40		
1.5.1.2	EDIA	15.00		
1.5.2	SHIELDING		230.10	
1.5.2.1	SUPPORT TABLES	30.00		
1.5.2.2	SHIELDING(VAULT UNOCCUPIED)	75.00		
1.5.2.3	SECURITY	3.00		
1.5.2.4	SHIELDING(VAULT OCCUPIED)	72.00		
1.5.2.5	BEAMLINES	15.00		
1.5.2.6	EDIA	35.10		
1.5.3	RADIATION SAFETY		486.00	
1.5.3.1	TRANSFER LINE INTERLOCKS	14.50		
1.5.3.2	CONTROLLED ACCESS ZONE	2.00		
1.5.3.3	AREA MONITORING	34.90		
1.5.3.4	SAFETY SHUTTERS	396.00		
1.5.3.5	MISC. INTERLOCKS	10.00		
1.5.3.6	EDIA	29.40		
1.6	CONTINGENCIES			2370.00
1.6.1	ALADDIN MAIN RING (20%)		800.00	
1.6.2	INJECTION TRANSPORT SYSTEM (20%)		320.00	
1.6.3	CONTROL SYSTEM (20%)		200.00	
1.6.4	800 MEV INJECTOR (10%)		700.00	
1.6.5	CONVENTIONAL FACILITIES (15%)		350.00	

ALADDIN UPGRADE PROJECT

'Engineer's Cost Estimate

Major Component/Subcomponent	WBS	Date	INITIAL	NAME	FILENAME	NOTES
RADIATION SAFETY/BEAM LINE	1.5.3.4	4/10/85	AVR/JAH	RAUCHAS	BLSAFE	BEAM LINE RADIATION SAFETY

Item No.	ITEM TITLE	Material Unit Meas.	Material No. Units	Material Unit Cost	Material Cost Basis	Material Total Mt K$	Labor No. Units	Labor Unit Hrs.	Labor Total Hours	Craft Code	$/Hr	Total Labor K$	MATL. & LABOR TOTAL $
1	SAFETY SHUTTER	EA	20	14000	EU	280.000	20	0	0.0			0.000	280.000
2	FABRICATION	EA	20	0	EU	0.000	20	40	800.0	S1	40.00	32.000	32.000
3	ASSEMBLY	EA	20	0	EU	0.000	20	10	200.0	T2	40.38	8.076	8.076
4	INSTALL & TEST	EA	20	0	EU	0.000	20	10	200.0	T2	40.38	8.076	8.076
5	DRAFTING	EA	1	0	EU	0.000	1	20	20.0	DR	34.60	0.692	0.692
6						0.000			0.0			0.000	0.000
7						0.000			0.0			0.000	0.000
8	VACUUM VALVE INTLKS	EA	36	1000	EU	36.000	36	0	0.0			0.000	36.000
9	FABRICATION	EA	36	0	EU	0.000	36	8	288.0	S1	40.00	11.520	11.520
10	ASSEMBLY	EA	36	0	EU	0.000	36	8	288.0	T2	40.38	11.629	11.629
11	INSTALL & TEST	EA	36	0	EU	0.000	36	8	288.0	T2	40.38	11.629	11.629
12	DRAFTING	EA	1	0	EU	0.000	1	20	20.0	DR	34.60	0.692	2
						316.000			2104.0			84.315	400.315

APPENDIX B

COST ESTIMATE ESCALATION FACTORS

PART A - Escalating costs of past years to FY86 levels.

FISCAL YEAR	INFLATION %	SCALING FACTOR
1970	9.0	3.533
1971	10.9	3.241
1972	7.0	2.922
1973	6.8	2.731
1974	12.8	2.557
1975	9.0	2.267
1976	6.8	2.080
1977	9.2	1.948
1978	8.7	1.784
1979	10.2	1.641
1980	10.5	1.489
1981	9.1	1.348
1982	6.2	1.235
1983	5.2	1.163
1984	6.5	1.105
1985	3.8	1.038
1986	---	1.000

NOTE: The yearly inflation factors for Part A come from DOE-HEP 1981 "Analysis of Cost and Price Changes", HEP-81402 and subsequent updates. These factors as stated represent a typical major construction project at HEP laboratories which demonstrate typically a cost distribution of 70% conventional construction and 30% technical components.

Part B - Escalating FY86 costs to future years.

FISCAL YEAR	INFLATION %	SCALING FACTOR
1986	---	1.000
1987	5.0	1.050
1988	5.8	1.111
1989	6.1	1.179
1990	6.3	1.253
1991	6.4	1.333

NOTE: The yearly inflation factors for Part B are taken from the following reference: Letter, D. T. Goldman to A. Schriesheim, "Updated Economic Escalation Rates for DOE Construction Projects," dated August 13, 1985, and are based on the materials and labor data contained in the Energy Supply Planning Model and appropriate escalation rates forecasted by Data Resources, Incorporated (DRI).

October 11, 1985

APPENDIX C

CRAFT CODE / RATE TABLE

NOTE: This is a simplified list of all available craft codes that appear most relevant to this project. The craft rates listed are in FY85$ and will be updated in the subsequent spread-sheet cost summaries. These rates are to be used for the present.

	Craft Code	Rate $/hr
* MANUFACTURING/FABRICATION/ASSEMBLY/TEST:		
Technician(Assy,tst,etc.),relatively unskilled	T1	21.00
Technician(Assy,tst,etc.),experienced/skilled	T2	32.00
Shops(Average capability machinists,fab.,etc.)	S1	37.00
Shops(Specialized,precision,high tech,etc.)	S2	42.00
Factory Support(Parts handling,inspectors,QA,etc)	F1	32.00
Factory Support(Superv,mangrs,prod.engr.,etc)	F2	42.00
* INSTALLATION: (Assumes "Davis-Bacon")		
Plumber, Steam Fitter, Sheet Metal	IP	37.00
Electrician	IE	34.00
Carpenter, Painter, Rigger, Crane Operator	IC	32.00
Laborer	IL	26.00
Technician	IT	26.00
** TECHNICAL DESIGN (and Construction where applicable) ENGINEERING / DESIGN / INSPECTION:		
Physicist	PH	32.00
Engineer (Mechanical and Electrical)	EN	32.00
Designer/Coordinator	DC	21.00
Drafter	DR	16.00

* Includes hourly base pay, employee benefits, and overhead & profit for "outside" vendor or contractor.

** Includes effective hourly base pay and benefits, but does not include laboratory overhead (which will be included in a seperate WBS category).

DRAFT
October 23, 1985
AVR

6 GeV LIGHT SOURCE PROJECT
WORK BREAKDOWN STRUCTURE

1. 6 GEV Light Source Project

1.1 Project Management

1.1.1 Administrative
- 1.1.1.1 Manpower management
- 1.1.1.2 Cost control
- 1.1.1.3 Schedule control
- 1.1.1.4 Procurement

1.1.2 Technical
- 1.1.2.1 Design
- 1.1.2.2 Quality Assurance
- 1.1.2.3 Safety

1.2 Pre-Construction R&D

1.2.1 Theoretical
- 1.2.1.1 Accelerator Physics
- 1.2.1.2 Experimental Physics

1.2.2 Technical
- 1.2.2.1 Vacuum
- 1.2.2.2 Diagnostics
- 1.2.2.3 Control and Monitoring
- 1.2.2.4 Computer Systems

1.3 Injector

1.3.1 Linac
- 1.3.1.1 Electron Gun
- 1.3.1.2 Positron Converter
- 1.3.1.3 Accelerator Cavities
- 1.3.1.4 RF Power
- 1.3.1.5 Vacuum
- 1.3.1.6 Diagnostics
- 1.3.1.7 Control and Monitoring
- 1.3.1.8 Shielding
- 1.3.1.9 Security/Interlocks

1.3.2 Positron Accumulator/Booster
- 1.3.2.1 Magnets & Supports
- 1.3.2.2 Power Supplies
- 1.3.2.3 Vacuum
- 1.3.2.4 RF System
- 1.3.2.5 Diagnostics
- 1.3.2.6 Control and Monitoring
- 1.3.2.7 Shielding
- 1.3.2.8 Security/Interlocks

1.3.3 Beam Transport
- 1.3.3.1 Magnets & Supports
- 1.3.3.2 Power Supplies
- 1.3.3.3 Vacuum
- 1.3.3.4 Diagnostics
- 1.3.3.5 Control and Monitoring
- 1.3.3.6 Shielding
- 1.3.3.7 Security/Interlocks

1.4 Storage Ring

1.4.1 Magnets & Supports

1.4.2 Power Supplies

1.4.3 Vacuum

1.4.4 RF System

1.4.5 Diagnostics

1.4.6 Control and Monitoring

1.4.7 Shielding

1.4.8 Security/Interlocks

1.5 Insertion Devices and Beam Lines

1.5.1 Wiggler Beamline
- 1.5.1.1 Wiggler & Cryogenics
- 1.5.1.2 Front End
- 1.5.1.3 Vacuum
- 1.5.1.4 Shielding
- 1.5.1.5 Photon Beam Diagnostics/Control
- 1.5.1.6 Monochromator/Mirror Systems
- 1.5.1.7 Experimental Station
- 1.5.1.8 Data Acquisition & Computer Control
- 1.5.1.9 Vacuum & Safety Interlocks

1.5.2 Undulator Beamline
- 1.5.2.1 Undulator
- 1.5.2.2 Front End
- 1.5.2.3 Vacuum
- 1.5.2.4 Shielding
- 1.5.2.5 Photon Beam Diagnostics/Control
- 1.5.2.6 Monochromator/Mirror Systems
- 1.5.2.7 Experimental Station
- 1.5.2.8 Data Acquisition & Computer Control
- 1.5.2.9 Vacuum & Safety Interlocks

1.5.3 Dipole Beamline
- 1.5.3.1 Front End
- 1.5.3.2 Vacuum
- 1.5.3.3 Shielding
- 1.5.3.4 Photon Beam Diagnostics/Control
- 1.5.3.5 Monochromator/Mirror Systems
- 1.5.3.6 Experimental Station
- 1.5.3.7 Data Acquisition & Computer Control
- 1.5.3.8 Vacuum & Safety Interlocks

1.6 Central Control and Monitoring

1.6.1 Central Computing Facility

1.6.2 Main Control Room Equipment

1.6.3 Ancillary Control and Monitoring Equipment

1.6.4 Networks

1.7 Conventional Construction

1.7.1 Site Preparation

1.7.2 Injector Buildings
- 1.7.2.1 Linac Building
- 1.7.2.2 Booster Building
- 1.7.2.3 Beam Transport Tunnels

1.7.3 Storage Ring & Experimental Hall
- 1.7.3.1 Storage Ring
- 1.7.3.2 Experimental Hall
- 1.7.3.3 Laboratories
- 1.7.3.4 Support Areas
- 1.7.3.5 Building Services Areas

1.7.4 Main Office and Laboratory Building

1.7.5 Lodging Facilities

1.7.6 Utilities & Distribution

1.7.7 Equipment & Furnishings

1.8 Engineering, Design, Inspection (ED&I)

1.8.1 Injector ED&I

1.8.2 Storage Ring ED&I

1.8.3 Insertion Devices and Beamline ED&I

1.8.4 AE/CM Services (conventional construction)

1.9 Contingencies

1.9.1 Project Management

1.9.2 Pre-Construction R&D

1.9.3 Injector

1.9.4 Storage Ring

1.9.5 Insertion Devices and Beamlines

1.9.6 Central Control and Monitoring

1.9.7 Conventional Construction